

MMWR

Supplement

MORBIDITY AND MORTALITY WEEKLY REPORT

**NIOSH
Recommendations
for
Occupational Safety
and
Health Standards**

September 1986

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
National Institute for Occupational Safety and Health
Centers for Disease Control
Atlanta, Georgia 30333**

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INTRODUCTION

Acting under the authority of the Occupational Safety and Health Act of 1970 (Public Law 91-596), the National Institute for Occupational Safety and Health (NIOSH) develops, and periodically revises, recommendations for limits of exposure to potentially hazardous substances or conditions in the workplace. It also recommends preventive measures designed to reduce or eliminate adverse health effects associated with these hazards. In formulating these recommendations, NIOSH evaluates all known and available scientific information relevant to the potential hazard. These recommendations are then published and transmitted to the Department of Labor, Occupational Safety and Health Administration (OSHA) or Mine Safety and Health Administration (MSHA) for use in promulgating legal standards.

NIOSH recommendations are published in a variety of documents. Criteria Documents specify a NIOSH Recommended Exposure Limit (REL) and appropriate preventive measures designed to reduce or eliminate adverse health effects. Special Hazard Reviews, Occupational Hazard Assessments, and Technical Guidelines are other types of documents published by NIOSH to complement the Institute's recommendations for standards. These documents provide assessments, from a safety and health standpoint, of specific problems associated with a given agent or hazard and recommend appropriate control and surveillance methods.

Although these documents do not supplant the more comprehensive Criteria Document, they are prepared in such a way as to assist OSHA in the formulation of regulations. NIOSH also periodically presents testimony before various Congressional committees and at regulatory hearings convened by OSHA. The testimony presented always includes the current NIOSH policy concerning the particular hazard in question.

NIOSH also publishes documents known as Current Intelligence Bulletins (CIB) which review and evaluate emerging information on occupational hazards. These bulletins are based on the rapid evaluation of new and changing information on a particular hazard in light of existing knowledge.

The "NIOSH Recommendations for Occupational Safety and Health Standards" are based on existing NIOSH policy as previously published in any of the forms listed above. The intent of this table is to provide, in rapid-reference form, the most recent NIOSH REL or other recommendation for each potential hazard. The current OSHA Permissible Exposure Limit (PEL) or standard is also presented. Unless otherwise noted in the table, the NIOSH recommendations were originally published in Criteria Documents.

Note to Readers:

Copies of NIOSH publications are generally available from the U.S. Government Printing Office and the National Technical Information Service. Single copies of these publications may be obtained (while the supply lasts) from:

Publications Dissemination
Division of Standards Development
and Technology Transfer
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226
(513) 841-4287

Please enclose a self-addressed mailing label with your request.

Definitions of abbreviations and terms used in this publication:

Action level	the exposure concentration at which certain provisions of the NIOSH recommended standard must be initiated, such as periodic measurements of worker exposure, training of workers, and medical surveillance
Ca	NIOSH recommends that the substance be treated as a potential human carcinogen
CFR	Code of Federal Regulations
CIB	Current Intelligence Bulletin
dBA	decibel, weighted according to the A scale, which approximates the response of the human ear
ECG	electrocardiogram
J/cm ²	joules per square centimeter
μm	micrometer
μg/m ³	micrograms per cubic meter
mg/m ³	milligrams per cubic meter
mppcf	millions of particles per cubic foot
mW/cm ²	milliwatts per square centimeter
nm	nanometer
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PCB's	polychlorinated biphenyls
PCDD's	polychlorinated dibenzo- <i>p</i> -dioxins
PCDF's	polychlorinated dibenzofurans
PEL	Permissible Exposure Limit (OSHA)
ppb	parts per billion
ppm	parts per million
REL	Recommended Exposure Limit (NIOSH)
(Skin)	potential contribution to overall exposure by the cutaneous route including mucous membranes and eyes
TCDD	2,3,7,8-tetrachlorodibenzo- <i>p</i> -dioxin
TWA	time-weighted average



SUMMARY OF OSHA REGULATIONS AND FOR OCCUPATIONAL SAFETY AND HEALTH

Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
2-Acetylaminofluorene (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1014	Ca Use 29 CFR 1910.1014
Acetylene (July 1976)	2,500 ppm (10% of lower explosive limit)	No exposure > 2,500 ppm (2,662 mg/m ³)
Acrylamide (October 1976)	0.3 mg/m ³ , 8-hr TWA (Skin)	0.3 mg/m ³ TWA
Acrylonitrile (January 1978; revised March 1978 as part of NIOSH testimony at OSHA hearing)	2 ppm, 8-hr TWA; 10 ppm ceiling (15 min) (Skin) 29 CFR 1910.1045	Ca 1 ppm, 8-hr TWA; 10 ppm ceiling (15 min) (Skin)
Aldrin/dieldrin (Special Hazard Review September 1978)	0.25 mg/m ³ , 8-hr TWA (Skin)	Ca Lowest reliably detectable level

*Date recommendation was published or testimony presented is in parentheses.

[†]NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted.

[§]Unless otherwise noted health effects cited are for humans.

**S AND NIOSH RECOMMENDATIONS
AND HEALTH STANDARDS, 1986**

NIOSH		
	Health Effect(s) Considered ^s	Comments
4	Potential for cancer in humans; produced tumors of the liver, bladder, lungs, pancreas, and skin in animals	None
ppm	Asphyxia	Employers to check for and inform workers of contaminants such as arsine and phosphine
	Skin, eye, and nervous system effects	Prevent skin and eye contact
ppm	Brain tumors; lung and bowel cancer	Chest x ray required; first-aid and medical kits to be available during use; prevent skin contact
	Potential for cancer in humans; produced tumors of the lungs, liver, thyroid, and adrenal glands in animals	Aldrin/dieldrin no longer produced in U.S.; prevent skin contact

os.
s otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL's†/Other Recommendations
Alkanes (C5-C8) (March 1977)	All are 8-hr TWA values: Pentane: 1,000 ppm (2,950 mg/m ³); n-hexane: 500 ppm (1,800 mg/m ³); n-heptane: 500 ppm (2,000 mg/m ³); octane: 500 ppm (2,350 mg/m ³)	All are TWA values: Pentane: 120 ppm (350 mg/m ³); hexane: 100 ppm (350 mg/m ³); heptane: 85 ppm (350 mg/m ³); octane: 75 ppm (350 mg/m ³); Mixtures not to exceed 350 mg/m ³ TWA; All are ceiling values (1 min) for mixtures: pentane: 610 ppm (1,800 mg/m ³); hexane: 510 ppm (1,800 mg/m ³); heptane: 440 ppm (1,800 mg/m ³); octane: 385 ppm (1,800 mg/m ³); Action level set at 200 mg/m ³ for these substances
Allyl chloride (September 1976)	1 ppm (3 mg/m ³), 8-hr TWA	1 ppm (3.1 mg/m ³) TWA (9.3 mg/m ³) ceiling (1 min)
4-Aminodiphenyl (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent 29 CFR 1910.1011 Stringent workplace controls, recordkeeping, and medical surveillance required	Ca Use 29 CFR 1910.1011
Ammonia (July 1974)	50 ppm (35 mg/m ³), 8-hr TWA	50 ppm (34.8 mg/m ³) ceiling (5 min)
Anesthetic gases (see Waste anesthetic gases)		

Animal rendering
processes
(Occupational
Hazard Assessment
March 1981)

OSHA PEL's or NIOSH REL's for specific hazards are app

Antimony
(September
1978)

0.5 mg Sb/m³, 8-hr TWA

0.5 mg Sb/m³ TWA

Arsenic,
inorganic
(September
1974; revised
June 1975;
reaffirmed July
1982 as part
of NIOSH
testimony at
OSHA hearing)

10 µg As/m³, 8-hr TWA
29 CFR 1910.1018

Ca
2 µg As/m³ ceiling (1

Arsine
(CIB
August 1979)

0.2 mg/m³ (0.05 ppm),
8-hr TWA

Ca
2 µg As/m³ (0.002
ceiling (15 min)

Asbestos
(January 1972;
revised
December 1976;
revised
March 1984 as
part of NIOSH
testimony at
Congressional
hearing;

200,000 fibers/m³,
over 5 µm in length,
8-hr TWA; Action level
of 100,000 fibers/m³,
8-hr TWA
29 CFR 1910.1001

Ca
100,000 fibers/m³,
in length, 8-hr TWA
400-liter air sample

[Continued on next page]

*Date recommendation was published or testimony presented is in parentheses

†NIOSH TWA recommendations are based on exposures up to 10 hours unless

§Unless otherwise noted health effects cited are for humans.

e applicable

Mechanical injury; burns;
heat stress; infections
from biologic agents;
chemical hazards

Guidelines for engineering
controls and work practices
to reduce injury and
illness presented

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TWA

Irritation; cardiovascular
and lung effects

Chest x ray, pulmonary
function testing, and
electrocardiogram required

ing (15 min)

Lung and lymphatic
cancer; dermatitis

Chest x ray required

002 mg As/m³)

Sudden extensive
hemolysis

Workers to be warned of
working with arsenic
compounds in presence of
freshly formed
hydrogen

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/m³, over 5 μ m
TWA in a
sample

Lung cancer;
mesothelioma;
asbestosis

Chest x ray and pulmonary
function testing required

antheses.

s unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
reaffirmed June 1984 as NIOSH testimony at OSHA hearing)		
Asphalt fumes (September 1977)	None	5 mg/m ³ ceiling, measure total particulate (15 min)
Benzene (July 1974; revised August 1976; revised July 1977 as part of NIOSH testimony at OSHA hearing; revised March 1986 as part of NIOSH testimony at OSHA hearing)	10 ppm, 8-hr TWA; 25 ppm acceptable ceiling; 50 ppm maximum ceiling (10 min)	Ca 0.1 ppm (0.32 mg/m ³) 1 ppm (3.2 mg/m ³) ceiling (15 min)
Benzidine (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent 29 CFR 1910.1010 Stringent workplace controls, recordkeeping, and medical surveillance required	Ca Use 29 CFR 1910.1010

NIOSH

Health Effect(s)
Considered⁹

Comments

measured as
5 min)

Eye and respiratory
irritation

Medical surveillance
required; prevent
skin contact

(m³) 8-hr TWA;
)

Cancer (leukemia)

Prevent skin contact

1010

Bladder, liver, and
kidney cancer

None

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Benzidine-based dyes (Special Hazard Review January 1980; revised in "Preventing health hazards from . . . benzidine congener dyes" January 1983)

No PEL for benzidine-based dyes

Ca
Reduce exposure to lowest feasible level; replace with less toxic materials

Benzoyl peroxide (June 1977)

5 mg/m³, 8-hr TWA

5 mg/m³ TWA

Benzyl chloride (August 1978)

5 mg/m³ (1 ppm), 8-hr TWA

5 mg/m³ ceiling (15

Beryllium (June 1972; revised August 1977 as part of NIOSH testimony at OSHA hearing)

2 µg/m³, 8-hr TWA;
5 µg/m³ acceptable ceiling; 25 µg/m³ maximum ceiling (30 min)

Ca
Not to exceed 0.5 µg

Boron trifluoride (December 1978)

1 ppm (3 mg/m³) ceiling

No exposure limit recommended due to the absence of reliable monitoring methods

1,3-Butadiene (CIB February 1984)

1,000 ppm (2,200 mg/m³), 8-hr TWA

Ca
Reduce exposure to lowest feasible level

*Date recommendation was published or testimony presented is in parentheses

†NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted

§Unless otherwise noted health effects cited are for humans.

e to level; s	Bladder cancer	Stringent workplace controls and medical surveillance required. Urine monitoring for benzidine suggested
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	Respiratory and eye irritation; skin effects	None
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(15 min)	Irritation; skin and eye effects	Chest x ray and pulmonary function testing required
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5 $\mu\text{g Be/m}^3$	Lung cancer	Pulmonary function testing and chest x ray required
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mit recommended nce of a ring method	Respiratory effects	Appropriate engineering and work-practice controls to reduce exposure to lowest feasible level; pulmonary function testing required
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re to level	Hematopoietic cancer; teratogenicity; reproductive system effects	Appropriate engineering and work-practice controls; restrict access to areas where 1,3-butadiene is used
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nteses.

s unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Cadmium (August 1976; revised in CIB September 1984)	Fume: 0.1 mg/m ³ , 8-hr TWA; 0.3 mg/m ³ ceiling; dust: 0.2 mg/m ³ , 8-hr TWA; 0.6 mg/m ³ ceiling	Ca Reduce exposure to lowest feasible level
Carbaryl (September 1976)	5 mg/m ³ , 8-hr TWA	5 mg/m ³ TWA
Carbon black (September 1978)	3.5 mg/m ³ , 8-hr TWA	3.5 mg/m ³ TWA; Ca 0.1 mg/m ³ TWA in presence of polycyclic aromatic hydrocarbons
Carbon dioxide (August 1976)	5,000 ppm (9,000 mg/m ³), 8-hr TWA	10,000 ppm (18,000 mg/m ³) 30,000 ppm (54,000 mg/m ³) ceiling (10 min)
Carbon disulfide (May 1977)	20 ppm, 8-hr TWA; 30 ppm acceptable ceiling; 100 ppm maximum ceiling (30 min)	1 ppm (3 mg/m ³) TWA; 10 (30 mg/m ³) ceiling (15 min)
Carbon monoxide (August 1972)	50 ppm (55 mg/m ³), 8-hr TWA	35 ppm (40 mg/m ³), 8-hr T 200 ppm (229 mg/m ³) ceiling (no defined time)

NIOSH

Health Effect(s)
Considered⁵

Comments

Lung cancer, prostatic
cancer, renal
system effects

None

Central nervous system
and reproductive
system effects

Workers to be warned of
possible effects on
reproductive system and to
have only minimum exposure
during pregnancy; prevent
skin and eye contact

Lung, cardiovascular
and skin effects;
cancer of the lymphatic-
bone marrow complex
when exposed to carbon
black in the presence
of polycyclic aromatic
hydrocarbons

Chest x rays, pulmonary
function testing, and ECG
required

(mg/m³) TWA;
(mg/m³)

Respiratory effects

None

; 10 ppm
(min)

Cardiovascular, central
nervous system, and
reproductive system
effects

Workers to be advised
of potential effects on
reproductive system

1-hr TWA;
(ceiling

Cardiovascular effects

None

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Carbon tetrachloride (December 1975; revised June 1976)	10 ppm, 8-hr TWA; 25 ppm acceptable ceiling; 200 ppm maximum ceiling (15 min in 4 hr)	Ca 2 ppm (12.6 mg/m ³) 45-liter sample (60 min)
Chlorine (May 1976)	1 ppm (3 mg/m ³) ceiling	0.5 ppm (1.45 mg/m ³) (15 min)
Chloroethane (CIB August 1978)	1,000 ppm (2,600 mg/m ³), 8-hr TWA	To be handled in the workplace with caution
Chloroform (September 1974; revised June 1976)	50 ppm (240 mg/m ³) ceiling	Ca 2 ppm (9.78 mg/m ³) 45-liter sample (60 min)
bis-Chloromethyl ether (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1008	Ca Use 29 CFR 1910.1008
Chloroprene (August 1977)	25 ppm (90 mg/m ³), 8-hr TWA	Ca 1 ppm (3.6 mg/m ³) (15 min)
Chromic acid (July 1973; revised—see Chromium (VI) December 1975)	1 mg/10 m ³ (100 µg/m ³) ceiling	25 µg/m ³ (0.025 mg/m ³) 50 µg/m ³ (0.05 mg/m ³) ceiling (15 min) as noncarcinogenic Cr(VI)

*Date recommendation was published or testimony presented is in parentheses.

†NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted.

§Unless otherwise noted health effects cited are for humans.

/m³) ceiling in a
(60 min)

Liver cancer

REL based on lower limit
of detection at time of
document publication

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g/m³) ceiling

Eye and respiratory
irritation

Chest x rays required

h the
caution

Central nervous system
effects; possible liver
and/or kidney effects

Exposures should be
minimized due to the
structural similarity
to the carcinogenic
chloroethanes

g/m³) ceiling in a
(60 min)

Liver or kidney tumors
and central nervous
system effects

None

10.1008

Lung cancer

None

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/m³) ceiling

Lung and skin cancer;
reproductive effects

Chest x ray and pulmonary
function testing required;
pregnant workers to be
counseled about continuing
work with chloroprene

25 mg/m³) TWA;
5 mg/m³)
as
ic Cr (VI)

Nasal ulceration

None

theses.

unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Chromium (VI) (December 1975)	1 mg/10 m ³ (100 µg/m ³) ceiling	Ca Carcinogenic Cr (VI): 1 µg/m ³ other Cr (VI): 25 µg/m ³ TWA 50 µg/m ³ ceiling (15 min)
Chrysene (Special Hazard Review June 1978)	0.2 mg/m ³ , 8-hr TWA	Ca To be controlled as an occupational carcinogen
Coal gasification plants (September 1978)	OSHA PEL's or NIOSH REL's for specific hazards are applicable	
Coal liquefaction, volumes I and II (Occupational Hazard Assessment March 1981)	OSHA PEL's or NIOSH REL's for specific hazards are applicable	
Coal tar products (September 1977)	0.2 mg/m ³ , 8-hr TWA (benzene-soluble fraction) 29 CFR 1910.1002 (coal tar pitch volatiles)	Ca 0.1 mg/m ³ TWA (cyclohexane-extractable fraction)

NIOSH		
	Health Effect(s) Considered ⁵	Comments
1 $\mu\text{g}/\text{m}^3$ TWA; m^3 TWA; 5 min)	Lung cancer, skin ulcers, and lung irritation	Employer must demonstrate absence of carcinogenic Cr (VI); x ray required
an ogen	Potential for cancer in humans; produced liver and skin tumors in animals	Document also contains control recommendations for polycyclic aromatic hydrocarbons
licable	Various effects depending on substances present; potential for skin cancer	Extensive work-practice and control procedures recommended
licable	Various effects depending on substances present; potential for skin cancer	Extensive work-practice and control procedures recommended
ctable	Lung and skin cancer	Includes coal tar, creosote, and coal-tar pitch; pulmonary function testing and chest x rays required

Cobalt
(Occupational
Hazard
Assessment
October 1981)

0.1 mg/m³, 8-hr TWA

NIOSH has concluded that
is insufficient evidence to
warrant recommending an
exposure limit

Coke oven
emissions
(February 1973;
revised
November 1975
as part of NIOSH
testimony at
OSHA hearing)

150 µg/m³, 8-hr TWA
29 CFR 1910.1029

Ca
0.5-0.7 mg/m³ (500-700
(total particulates)
as screening level

Confined
spaces,
working in
(December 1979)

Covered under numerous
OSHA regulations for
General Industry
(29 CFR 1910)

Various recommendations
including a permit system to
prevent worker injury and

Cotton dust
(September
1974; reaffirmed
September 1983
as part of NIOSH
testimony at
OSHA hearing)

Yarn manufacturing:
200 µg/m³, 8-hr TWA;
slashing and weaving
operations: 750 µg/m³,
8-hr TWA; all other
operations: 500 µg/m³,
8-hr TWA
29 CFR 1910.1043

<200 µg/m³ lint-free
cotton dust

Cresol
(February
1978)

5 ppm (22 mg/m³),
8-hr TWA (Skin)

2.3 ppm (10 mg/m³) TLV

*Date recommendation was published or testimony presented is in parentheses.

†NIOSH TWA recommendations are based on exposures up to 10 hours unless

§Unless otherwise noted health effects cited are for humans.

ed that there
nce to
ding a new

Dermatitis; potential for
pulmonary fibrosis

Includes recommendations
for engineering controls,
work practices, protective
equipment, worker education,
monitoring, and medical
surveillance

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0-700 $\mu\text{g}/\text{m}^3$)

Lung cancer

Chest x ray required;
work practices to
minimize exposure to
emissions

ications
system to
ary and death

Injury and death

None

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free

Pulmonary disease
(byssinosis)

Pulmonary function
testing required

m^3) TWA

Skin, liver, kidney, and
pancreas effects

Applies to mixtures of
cresols and cresylic acid;
prevent skin and eye
contact; possible
delayed effects

eses.

unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
DDT (Special Hazard Review September 1978)	1 mg/m ³ , 8-hr TWA (Skin)	Ca Lowest reliably detectable level; 0.5 mg/m ³ TWA by NIOSH-validated method
2,4-Diamino- anisole and its salts (CIB January 1978)	None	Ca Reduce exposure to lowest feasible level
o-Dianisidine- based dyes (Joint NIOSH/OSHA Health Hazard Alert December 1980)	None	Ca Should be handled in the workplace with caution; exposures should be minimized
Dibromochloro- propane (January 1978)	1 ppb, 8-hr TWA; eye and skin contact to be avoided 29 CFR 1910.1044	10 ppb (0.1 mg/m ³) TV (NIOSH recommendation superseded by OSHA standard promulgated in 1978)
3,3'-Dichloro- benzidine (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1007	Ca Use 29 CFR 1910.1007

NIOSH

Health Effect(s)
Considered⁵

Comments

ectable
WA by
method

Potential for cancer
in humans; produced
tumors of the liver,
lungs, and lymphatic
system in animals

Prevent skin contact

o
el

Potential for cancer
in humans; produced
tumors of the thyroid,
skin, and lymphatic
system in animals

Prevent skin contact;
engineering and work-
practice controls are
recommended

l in the
ution;
be

Potential for cancer
in humans; produced
tumors of the bladder,
stomach, and mammary
glands in animals

Substitute less toxic dyes
wherever possible

³) TWA
ndation
HA
ated

Sterility; renal and
liver effects

Regulated by OSHA as
a carcinogen

1007

Potential for cancer
in humans; produced
tumors of the liver,
bladder, and lungs
in animals

None

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1,1-Dichloro-
ethane (CIB
August 1978)

100 ppm (400 mg/m³),
8-hr TWA

To be handled in the
workplace with caution

Dieldrin
(see Aldrin/
dieldrin)

Di-2-Ethylhexyl
Phthalate
(DEHP) (Special
Hazard Review
March 1983)

5 mg/m³, 8-hr TWA

Ca
Reduce exposure to
lowest feasible level

Diisocyanates
(September
1978)

Toluene diisocyanate
(TDI): 0.02 ppm
(0.14 mg/m³) ceiling;
diphenylmethane
diisocyanate (MDI):
0.02 ppm (0.2 mg/m³)
ceiling

All values given in μ m
ceiling values for 10
(each equivalent to 5
TWA and 20 ppb ceiling
TDI: 35 TWA, 140 ceiling
MDI: 50 TWA, 200 ceiling
hexamethylene diisocyanate
35 TWA, 140 ceiling
naphthalene diisocyanate
40 TWA, 170 ceiling
isophorone diisocyanate
45 TWA, 180 ceiling
hexylmethane-4,4'-diisocyanate
(hydrogenated MDI)
210 ceiling; other diisocyanates
to be controlled to 20
and 5 ppb TWA

*Date recommendation was published or testimony presented is in parentheses

†NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted

§Unless otherwise noted health effects cited are for humans.

in the
caution

Central nervous system
effects; possible liver
and/or kidney damage

Exposures should be
minimized due to the
structural similarity
to the carcinogenic
chloroethanes

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re to
level

Potential for cancer
in humans; produced
liver tumors in animals

DEHP, widely used in the
quantitative fit testing of
respirators, should be
replaced with less
toxic material such
as refined corn oil

in $\mu\text{g}/\text{m}^3$ and all
or 10 min
nt to 5 ppb
b ceiling);
40 ceiling;
200 ceiling;
diisocyanate (HDI):
ceiling;
isocyanate (NDI):
ceiling;
isocyanate (IPDI):
ceiling; dicyclo-
4,4'-diisocyanate
MDI): 55 TWA,
her diisocyanates
d to 20 ppb ceiling

Respiratory effects and
sensitization; pulmonary
irritation

Chest x ray and pulmonary
function testing required

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nteses.

unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL's†/Other Recommendations
4-Dimethylamino-azobenzene (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1015	Ca Use 29 CFR 1910.1015
Dinitro-ortho-cresol (February 1978)	0.2 mg/m ³ , 8-hr TWA (Skin)	0.2 mg/m ³ TWA
Dinitro-toluenes (CIB July 1985)	1.5 mg/m ³ , 8-hr TWA (Skin)	Ca Reduce exposure to lowest feasible level
Dioxane (September 1977)	100 ppm (360 mg/m ³), 8-hr TWA (Skin)	Ca 1 ppm (3.6 mg/m ³) ceiling (30 min)
Dioxin (see 2,3,7,8-Tetrachloro-dibenzo- <i>p</i> -dioxin)		
Elevated workstations, emergency egress from (December 1975)	Sections under Subpart E, Means of Egress, General Industry Standards, and Subpart R, Special Industries (29 CFR 1910.261)	Various recommendations concerning means and availability of egress

NIOSH

Health Effect(s)
Considered⁹

Comments

015

Potential for cancer in humans; produced tumors of the liver and bladder in animals

None

Central nervous system and metabolic effects

Blood and urine monitoring required; prevent skin and eye contact; possible delayed effects

Potential for cancer in humans; produced tumors of the liver, skin, and kidneys in animals; reproductive system effects

Prevent skin contact

ceiling

Potential for cancer in humans; produced tumors of liver, lungs, and nasal cavity in animals; effects on liver and kidney

Blood and urine testing required; prevent skin contact

ations
and
ss

Trauma and injury

None

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Epichlorohydrin
(September
1976; revised
in CIB
October 1978)

5 ppm (19 mg/m³),
8-hr TWA

Ca
Occupational expo-
sure to epichlorohydrin to
be minimized

2-Ethoxy-
ethanol (see
Glycol ethers)

Ethyl chloride
(see
Chloroethane)

Ethylene
dibromide
(August 1977;
revised November
1983; reaffirmed
February 1984
as part of NIOSH
testimony at
OSHA hearing)

20 ppm, 8-hr TWA;
30 ppm acceptable
ceiling; 50 ppm
maximum peak (5 min)

Ca
0.045 ppm (0.38
8-hr TWA; 0.13 p
ceiling (15 min)

Ethylene
dichloride
(March 1976;
revised in CIB
April 1978;
revised
September 1978)

50 ppm, 8-hr TWA;
100 ppm acceptable
ceiling; 200 ppm
maximum ceiling
(5 min in 3 hr)

Ca
1 ppm (4 mg/m³)
2 ppm (8 mg/m³)
ceiling (15 min)

*Date recommendation was published or testimony presented is in parentheses.

[†]NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted.

[§]Unless otherwise noted health effects cited are for humans.

exposure to
rin to

Respiratory cancer;
mutagenesis; reproductive
effects; skin, kidney, liver,
and respiratory effects

Prevent skin contact

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0.38 mg/m³),
0.13 ppm (1 mg/m³)
(in)

Potential for cancer in
humans; mutagenesis;
damage to skin, eyes,
cardiovascular, liver, spleen,
reproductive, respiratory, and
central nervous systems

Workers to be warned of
potential for reproductive
abnormalities and cancer;
hazardous liquid; prevent
skin contact

MSDS

/m³) TWA;
/m³)
(in)

Potential for cancer in
humans; nervous system,
respiratory, cardiovascular,
and liver effects

Nursing infants of exposed
mothers at risk

parentheses.

ours unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Ethyleneimine (NIOSH testimony at OSHA hearing September 1973)	0.5 ppm (1 mg/m ³), 8-hr TWA (Skin) 29 CFR 1910.1012	Ca Use 29 CFR 1910.1012
Ethylene oxide (Special Hazard Review September 1977; revised July 1983 as part of NIOSH testimony at OSHA hearing)	1 ppm (1.8 mg/m ³), 8-hr TWA 29 CFR 1910.1047	Ca 5 ppm (9 mg/m ³) ceiling (10 min/day); <0.1 ppm (0.18 mg/m ³), 8-hr TWA
Ethylene thiourea (Special Hazard Review October 1978)	None	Ca Should be used in encapsulated form in industry; worker exposure be minimized
Excavations, development of draft construction safety standards for (Technical Guideline May 1983)	Many aspects covered under OSHA regulations governing excavations, trenching, and shoring practices in the construction industry (29 CFR 1926, Subpart P)	Many work-practice recommendations concern safety standards for excavations
Fibrous glass (April 1977)	Nuisance dust PEL applies, 15 mg/m ³ total dust; 5 mg/m ³ respirable fraction	3 million fibers/m ³ TWA (fibers \leq 3.5 μ m diamet \geq 10 μ m length); 5 mg/ (total fibrous glass)

NIOSH

**Health Effect(s)
Considered⁵**

Comments

012

Potential for cancer in humans; produced tumors of the liver and lung in animals

Stringent workplace controls and medical surveillance required

iling
ppm
TWA

Peritoneal cancer; leukemia; mutagenesis; reproductive effects

Blood monitoring and medical counseling recommended

n
posure to

Potential for cancer and teratogenicity in humans; produced tumors of the liver, thyroid, and lymphatic system in animals

Workers to be informed of carcinogenic and teratogenic hazards; special attention to be given to thyroid function tests

concerning

Injury and death

None

TWA
ameter and
mg/m³ TWA

Eye, skin, and respiratory effects

NIOSH recommends that this REL also apply to other synthetic fibers

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Fluorides,
inorganic
(June 1975)

2.5 mg F/m³, 8-hr TWA

2.5 mg F/m³ TWA

Fluorocarbon
polymers,
decomposition
products of
(September
1977)

None

Various recommendations
emphasizing good work
practices, engineering
controls, and medical surveillance

Formaldehyde
(December 1976;
revised in CIB
April 1981;
revised May
1986 as part
of NIOSH
testimony at
OSHA hearing)

3 ppm, 8-hr TWA; 5 ppm
acceptable ceiling;
10 ppm maximum ceiling
(30 min)

Ca
0.1 ppm ceiling (15 min)
represents the lowest
quantifiable concentration

Foundries
(September
1985)

Many aspects covered
under the numerous OSHA
regulations for general
industry (29 CFR 1910)

Various recommendations
emphasizing good work
practices, engineering
controls, and medical
surveillance

Furfuryl
alcohol
(March 1979)

50 ppm (200 mg/m³),
8-hr TWA

50 ppm (200 mg/m³)

*Date recommendation was published or testimony presented is in parentheses

†NIOSH TWA recommendations are based on exposures up to 10 hours unless

§Unless otherwise noted health effects cited are for humans.

Kidney and bone effects

Urine monitoring required

Foundations
and work
engineering controls,
surveillance

Lung effects; polymer
fume fever

Workroom air to be
monitored for inorganic
fluorides and hydrogen
fluoride

(5 min);
invest reliably
concentration

Potential for cancer in
humans; produced tumors
of the nasal cavity
in animals

Medical surveillance;
skin protection

Foundations
and work
engineering
medical

Cancer; respiratory
disease; heat-induced
illness; noise-induced
hearing loss; vibration-
induced disorders; eye
injuries; traumatic
and ergonomic injuries

Recommendations limited to
foundries that pour molten
metal into sand molds

(/m³) TWA

Respiratory effects

None

theses.
unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Glycidyl ethers (June 1978; revised in CIB October 1978)	All values in ppm (mg/m ³): allyl glycidyl ether (AGE): 10 (45) ceiling; n-butyl glycidyl ether (BGE): 50 (270), 8-hr TWA; di-2,3-epoxypropyl ether (DGE): 0.5 (2.8), 8-hr TWA; isopropyl glycidyl ether (IGE): 50 (240), 8-hr TWA; phenyl glycidyl ether (PGE): 10 (60), 8-hr TWA	All are ceiling values (15 min) in ppm (mg/m ³): AGE: 9.6 (45); BGE: 4.4 (30); DGE: 0.2 (1) Ca; IGE: 50 (240); PGE: 1 (5)
Glycol ethers (CIB May 1983)	2-Methoxyethanol: 25 ppm (80 mg/m ³), 8-hr TWA (Skin); 2-ethoxyethanol: 200 ppm (740 mg/m ³), 8-hr TWA (Skin)	Reduce exposure to lowest feasible level
Grain elevators and feed mills, occupational safety in (Technical Guideline September 1983; reaffirmed June 1984 as part of NIOSH testimony at OSHA hearing)	Many general aspects (e.g., protective equipment, dust control, etc.) covered under the numerous OSHA regulations for general industry (29 CFR 1910)	Various recommendation control of combustible dusts and ignition source machine guarding, isolat and lockouts, bin entry, training, and personal protective equipment
Hexachloroethane (CIB August 1978)	1 ppm (10 mg/m ³), 8-hr TWA (Skin)	Ca Reduce exposure to lowest feasible level

NIOSH

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Health Effect(s)
Considered⁸

Comments

/m³):

DGE: Potential for cancer in humans; produced skin tumors in animals; DGE and other glycidyl ethers: skin and mucous membrane effects; sensitization potential; possible hematopoietic and reproductive system effects

Possible additive effects with mixtures; medical surveillance

Reproductive effects; teratogenicity

Prevent skin contact

MMWR

ations for
ble
ources,
solation
ntry,
al
nt

Injury and death

Health hazards from exposure to fumigants, pesticides, and grain dust

Potential for cancer in humans; produced liver tumors in animals

None

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Hot
environments
(June 1972;
revised
April 1986)

None

Sliding scale limits based
upon environmental and
metabolic heat loads

Hydrazines
(June 1978)

All values in ppm (mg/m³):
hydrazine: 1 (1.3), 8-hr
TWA; 1,1-dimethyl-
hydrazine: 0.5 (1.0), 8-hr
TWA; phenylhydrazine:
5 (22), 8-hr TWA;
methylhydrazine:
0.2 (0.35) ceiling

Ca
All are ceiling values (12
ppm (mg/m³): hydrazine
(0.04); 1,1-dimethylhydra-
zine (0.06 (0.15)); phenylhydra-
zine (0.14 (0.6)); methylhydra-
zine (0.04 (0.08))

Hydrogen cyanide
and cyanide
salts
(October 1976)

Hydrogen cyanide: 10 ppm
(11 mg/m³), 8-hr TWA (Skin);
cyanide: 5 mg CN/m³, 8-hr
TWA (Skin)

4.7 ppm (5 mg CN/m³)
(10 min)

Hydrogen
fluoride
(March 1976)

3 ppm, 8-hr TWA

3 ppm (2.5 mg F/m³)
TWA; 6 ppm (5.0 mg F/
ceiling (15 min)

Hydrogen
sulfide
(May 1977)

20 ppm acceptable
ceiling; 50 ppm maximum
ceiling (10 min)

10 ppm (15 mg/m³)
ceiling (10 min)

*Date recommendation was published or testimony presented is in parentheses.

†NIOSH TWA recommendations are based on exposures up to 10 hours unless noted.

§Unless otherwise noted health effects cited are for humans.

based
l and
ds

Heat-induced illnesses

Recommendations include
acclimatization, strict
work practices,
protective equipment,
and medical surveillance

s (120 min) in
razine: 0.03
ylthydrazine:
thydrazine:
hydrazine:

Potential for cancer in
humans; produced tumors of
the lung, liver, blood vessels,
and intestines in animals;
blood, liver, and skin effects

Blood and urine monitoring
and chest x ray required;
bowel examination for
workers over age 40

/m³) ceiling

Thyroid, blood, respiratory
system effects

Concurrent measurement
required for HCN when
measuring for cyanide
salt; trained first-aid
personnel and first-aid
kits to be available
during use; prevent
skin and eye contact

n³)
mg F/m³)

Skin, eye, and
airway irritation;
bone effects

Pelvic x ray (male
workers only) and
urine testing required

n³)

Irritation; severe acute
effects involving nervous
and respiratory systems

Continuous monitoring
required if potential
exists for exposure to
≥ 70 mg/m³ (47 ppm);
evacuation required
at this level

eses.

less otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Hydroquinone (April 1978)	2 mg/m ³ , 8-hr TWA	0.44 ppm (2 mg/m ³) ceiling (15 min)
Identification system for occupationally hazardous materials (December 1974)	Sections of Hazard Communication (29 CFR 1910.1200) and carcinogen standards may be applicable	Complete designation sys occupationally hazardous materials
Isopropyl alcohol (March 1976)	400 ppm (980 mg/m ³), 8-hr TWA	400 ppm (984 mg/m ³) T 800 ppm (1,968 mg/m ³) ceiling (15 min)
Kepone (January 1976)	None	Ca 1 µg/m ³ TWA
Ketones (June 1978)	All are 8-hr TWA values in ppm (mg/m ³): acetone: 1,000 (2,400); methyl ethyl ketone: 200 (590); methyl n-propyl ketone: 200 (700); methyl n-butyl ketone: 100 (410); methyl n-amyl ketone: 100 (465); methyl isobutyl ketone: 100 (410); methyl isoamyl ketone: none; diisobutyl ketone: 50 (290); cyclohexanone: 50 (200); mesityl oxide: 25 (100); diacetone alcohol: 50 (240); isophorone: 25 (140)	All are TWA values in ppm (mg/m ³): acetone: 250 (590); methyl ethyl ketone: 200 (590); methyl n-prop ketone: 150 (530); meth n-butyl ketone: 1 (4); methyl n-amyl ketone: 10 (465); methyl isobutyl ketone: 50 (200); methyl isoamyl ketone: 50 (230); diisobutyl ketone: 25 (14 cyclohexanone: 25 (100) mesityl oxide: 10 (40); diacetone alcohol: 50 (24 isophorone: 4 (23)

NIOSH

Health Effect(s)
Considered⁵

Comments

Eye and skin effects

Special provisions for
darkroom use

None

Includes definition, safety
data sheets, alert symbols,
and label statements

Mucous membrane irritation;
possible cancer threat
in manufacturing process

Stringent work practices
and medical surveillance
for manufacturing workers
required

Liver cancer; nervous
system effects

Liver function
testing required

Irritation; liver, kidney,
and nervous system effects

Urinalysis required;
workers exposed
to methyl n-butyl
ketone to be warned
of nervous system effects

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Land-based oil and gas well drilling, comprehensive safety recommendations for (Technical Guideline September 1983; reaffirmed March 1984 as part of NIOSH testimony at OSHA hearing)

Many aspects covered under the numerous OSHA regulations for general industry (29 CFR 1910)

Various recommendations for safe work practices and technologic improvements

Lead, inorganic (January 1973; revised May 1978)

50 $\mu\text{g Pb/m}^3$, 8-hr TWA; over 8-hr exposure to be determined by formula 29 CFR 1910.1025

< 100 $\mu\text{g Pb/m}^3$ TWA to be maintained so that worker blood lead remains $\leq 60 \mu\text{g}/100$

Lockout/tagout, guidelines for controlling hazardous energy during maintenance and servicing (Technical Guideline September 1983)

Many aspects covered under OSHA regulations for general industry (29 CFR 1910) and construction standards (29 CFR 1926)

Work-practice recommendations for controlling hazardous energy during maintenance and servicing activities

Logging from felling to first haul (July 1976)

None

Extensive work-practice and personal protective recommendations

Malathion (June 1976)

15 mg/m^3 , 8-hr TWA

15 mg/m^3 TWA

*Date recommendation was published or testimony presented is in parentheses

†NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted

‡Unless otherwise noted health effects cited are for humans.

ndations for
es and
vements

Injury and death

Many tasks, types of
equipment, and conditions
are not covered by
existing regulations

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TWA; air level
so
d lead
y/100g

Kidney, blood, and nervous
system effects

Blood monitoring required

commendations
azardous
aintenance
ivities

Injury and death

"Energy" defined in this
document as kinetic
energy, potential energy,
electrical energy, and
thermal energy

MMWR

practice
tection
is

Primarily trauma and falls

Tetanus toxoid inoculations
and first-aid programs
to be instituted

Nervous system effects

Prevent skin contact;
blood monitoring
required

theses.
unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Mercury, inorganic (August 1973)	0.1 mg/m ³ acceptable ceiling	0.05 mg Hg/m ³ , 8-hr TWA
2-Methoxy- ethanol (see Glycol ethers)		
Methyl alcohol (March 1976)	200 ppm (260 mg/m ³), 8-hr TWA	200 ppm (262 mg/m ³) 800 ppm (1,048 mg/n (15 min)
Methyl chloro- methyl ether (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1006	Ca Use 29 CFR 1910.100
4,4'- Methylenebis- (2-chloroaniline) (MOCA) (Special Hazard Review September 1978)	Standard formally revoked by OSHA, August 1975	Ca 3 µg/m ³ TWA (lowest detectable limit)
Methylene chloride (March 1976; revised April 1986 in CIB)	500 ppm, 8-hr TWA; 1,000 ppm acceptable ceiling; 2,000 ppm acceptable maximum peak for 5 min in any 2-hr period above the acceptable ceiling for an 8-hr shift	Ca Reduce exposure to lo feasible limit

NIOSH

Exposure	Health Effect(s) Considered ⁵	Comments
	Central nervous system and mental effects	Work practices, sanitation, monitoring, and medical surveillance emphasized
0.1006 g/m ³ TWA; mg/m ³ ceiling	Blindness; metabolic acidosis	None
0.1006	Lung cancer	None
Lowest	Potential for cancer in humans; produced liver and lung tumors in animals	Chest x ray; blood and urine testing required
Lowest	Potential for cancer in humans; produced tumors of the lung, liver, salivary, and mammary glands in animals	None

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4,4'-Methylene- dianiline (CIB July 1986)	None	Ca Reduce exposure to lowest feasible limit
Methyl parathion (September 1976)	None	0.2 mg/m ³ TWA
Monohalo- methanes (CIB September 1984)	Methyl chloride: 100 ppm, 8-hr TWA; 200 ppm ceiling; 300 ppm acceptable maximum peak for 5 min in any 3-hr period above the acceptable ceiling for an 8-hr shift; methyl bromide: 20 ppm (80 mg/m ³) ceiling (Skin); methyl iodide: 5 ppm (28 mg/m ³), 8-hr TWA (Skin)	Ca Exposure to methyl chloro- methyl bromide, and methyl iodide should be reduced to lowest feasible level
alpha-Naphthyl- amine (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1004	Ca Use 29 CFR 1910.1004
beta-Naphthyl- amine (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1009	Ca Use 29 CFR 1910.1009

*Date recommendation was published or testimony presented is in parentheses.

†NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted.

§Unless otherwise noted health effects cited are for humans.

lowest	Bladder cancer; skin and liver effects	Prevent skin contact
	Central nervous system effects	Prevent skin contact; blood monitoring required
chloride, methyl uced vel	Potential for cancer in humans; produced tumors of the kidney, forestomach, and lung in animals; methyl chloride should also be considered a potential teratogen	None

004	Bladder cancer	None
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009	Bladder cancer	None
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esses.
less otherwise noted.

Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Niax® Catalyst ESN (Joint NIOSH/ OSHA CIB May 1978)	OSHA and NIOSH recommend that exposure to Niax® Catalyst ESN and its components, dimethylaminopropionitrile and bis [2-(dimethylamino)ethyl] ether, be minimized	
Nickel carbonyl (Special Hazard Review May 1977)	1 ppb (7 µg/m³), 8-hr TWA	Ca 1 ppb (7 µg/m³) TWA (lowest detectable level)
Nickel, inorganic compounds (May 1977)	1 mg Ni/m³, 8-hr TWA	Ca 15 µg Ni/m³ TWA
Nitric acid (March 1976)	2 ppm (5 mg/m³), 8-hr TWA	2 ppm (5 mg/m³) TWA
Nitriles (September 1978)	Acetonitrile: 40 ppm (70 mg/m³), 8-hr TWA; tetramethyl succinonitrile: 0.5 ppm (3 mg/m³), 8-hr TWA (Skin)	All are TWA values in ppm (mg/m³): acetonitrile: 20 (3); n-butyronitrile: 8 (22); isobutyronitrile: 8 (22); propionitrile: 6 (14); malononitrile: 3 (8); adiponitrile: 4 (18); succinonitrile: 6 (20). All ceiling values (15 min) in ppm (mg/m³): acetone cyanohydrin: 1 (4); glycolonitrile: 2 (5); tetramethyl succinonitrile: When present as mixtures other sources of cyanide, exposure to be considered additive and environmental limit to be calculated.

NIOSH

	Health Effect(s) Considered ³	Comments
talyst	Urological disorders; nervous system effects	Work-practice and engineering controls to reduce exposure
ell)	Lung and nasal cancer	Chest x ray, pulmonary function testing, and urine monitoring required
	Lung and nasal cancer; skin effects	Chest x ray and pulmonary function testing required
A	Dental erosion; nasal/lung irritation	Prevent skin and eye contact; chest x ray required
ppm 20 (34); ;);	Hepatic, renal, respiratory, cardiovascular, gastrointestinal, and nervous system effects	Chest x ray and pulmonary function testing required; trained personnel and first-aid kits to be available during use; prevent skin and eye contact
min)		
1 (4);		
trile: 1 (6). ures or with ide, lered ental		

4-Nitrobiphenyl
(NIOSH testimony
at OSHA hearing
September 1973)

No PEL
Cancer-suspect agent
Stringent workplace controls,
recordkeeping, and medical
surveillance required
29 CFR 1910.1003

Ca
Use 29 CFR 1910.1003

Nitrogen,
oxides of
(March 1976)

NO₂: 5 ppm
(9 mg/m³) ceiling;
NO: 25 ppm (30 mg/m³),
8-hr TWA

NO₂: 1 ppm (1.8 mg/m³)
ceiling (15 min);
NO: 25 ppm (30 mg/m³)

Nitroglycerin and
ethylene glycol
dinitrate
(EGDN)
(June 1978)

Nitroglycerin: 2 mg/m³
(0.2 ppm) ceiling (Skin);
EGDN: 1 mg/m³ (0.2 ppm)
ceiling (Skin)

0.1 mg/m³ ceiling (20 min)
recommended limit for
either substance alone
or mixtures

2-Nitro-
naphthalene (CIB
December 1976)

None

Ca
Reduce exposure to
lowest feasible level

2-Nitropropane
(CIB April
1977; revised
October 1980
in Joint
OSHA/NIOSH Health
Hazard Alert)

25 ppm (90 mg/m³),
8-hr TWA

Ca
Reduce exposure to
lowest feasible level

N-Nitroso-
dimethylamine
(NIOSH testimony
at OSHA hearing
September 1973)

No PEL
Cancer-suspect agent
Stringent workplace controls,
recordkeeping, and medical
surveillance required
29 CFR 1910.1016

Ca
Use 29 CFR 1910.1016

*Date recommendation was published or testimony presented is in parentheses.

†NIOSH TWA recommendations are based on exposures up to 10 hours unless otherwise noted.

§Unless otherwise noted health effects cited are for humans.

0.1003

Potential for cancer in humans; produced bladder tumors in animals

None

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3 mg/m³
; 10 mg/m³ TWA

Respiratory and blood effects

Pulmonary function testing required

ing (20 min)
limit for
e alone

Circulatory system effects

Prevent skin contact

re to
level

Bladder cancer

Compound metabolizes to beta-naphthylamine, a known carcinogen

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re to
level

Potential for cancer in humans; produced liver tumors in rats

Medical monitoring with specific emphasis on liver function tests

10.1016

Potential for cancer in humans; produced tumors of the liver, kidney, lung, and nasal cavity in animals

None

theses.

s unless otherwise noted.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S ¹ /Other Recommendations
Noise (August 1972)	90 dBA, 8-hr TWA	85 dBA TWA; 115 dBA
Organotin compounds (November 1978)	0.1 mg/m ³ , 8-hr TWA	0.1 mg Sn/m ³ TWA
Paint and allied coating products, manufacture of (September 1984)	Many aspects covered under the numerous OSHA regulations for general industry (29 CFR 1910)	Various recommendations the handling of raw materials and finished products; dispersion of pigment or resin particulates; thinning, tinting, and shading; filling; and laboratory functions
Parathion (June 1976)	0.1 mg/m ³ , 8-hr TWA (Skin)	0.05 mg/m ³ TWA
Pentachloroethane (CIB August 1978)	None	To be handled in the workplace with caution
Pesticides, manufacture and formulation of (July 1978)	Current OSHA PEL's or previous NIOSH REL's to be followed; stringent work-practice and medical surveillance requirements to be instituted. Pesticides considered in groups based on toxicity.	

NIOSH		
	Health Effect(s) Considered ³	Comments
6 dBA ceiling	Hearing damage	None
10 dBA	Eye, skin, liver, nervous system, and cardiovascular effects	Chest x ray, blood and urine monitoring, eye tests, heart examination, and nervous system testing required; prevent skin and eye contact
Foundations for washed ion of articles; and and ns	Injury and a wide range of toxicities considered	Paint and allied coating products include paints, varnishes, lacquers, stains, putties, and paint and varnish removers
	Nervous system effects	Prevent skin contact; blood monitoring required
the ution	Central nervous system effects; possible liver and kidney effects	Exposures should be minimized due to the structural similarity to the carcinogenic chloroethanes
allance n	Wide range of toxicities considered; cancer; nervous and reproductive system effects	Blood monitoring required for some groups; workers to be warned of reproductive effects for some compounds; prevent skin contact

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Phenol (July 1976)	5 ppm (19 mg/m ³), 8-hr TWA (Skin)	5.2 ppm (20 mg/m ³) T 15.6 ppm (60 mg/m ³) (15 min)
Phenyl-beta- naphthylamine (CIB December 1976)	None	Ca Reduce exposure to lowest feasible level
Phosgene (February 1976)	0.1 ppm (0.4 mg/m ³), 8-hr TWA	0.1 ppm (0.4 mg/m ³) 0.2 ppm (0.8 mg/m ³) ceiling (15 min)
Polychlorinated biphenyls (September 1977)	42% chlorine: 1 mg/m ³ , 8-hr TWA; 54% chlorine: 0.5 mg/m ³ , 8-hr TWA	Ca 1 µg/m ³ TWA (the min reliably detectable con using the recommende and analytical method)
Polychlorinated biphenyls (PCB's), potential health hazards from electrical equipment fires or failures (CIB February 1986)	42% chlorine: 1 mg/m ³ , 8-hr TWA; 54% chlorine: 0.5 mg/m ³ , 8-hr TWA	Ca Reduce exposure to lo feasible limit

*Date recommendation was published or testimony presented is in parentheses

†NIOSH TWA recommendations are based on exposures up to 10 hours unless

§Unless otherwise noted health effects cited are for humans.

(m³) TWA;
(m³) ceiling

to
level

(m³) TWA;
(m³)

the minimum
concentration
needed sampling
methods)

to lowest

intheses.

unless otherwise noted.

Skin, eye, central nervous
system, liver, and
kidney effects

Bladder cancer

Respiratory effects

Potential for cancer in
humans; produced tumors
of the liver, pituitary gland
and leukemias in animals;
skin, liver, and reproductive
system effects

Potential for cancer in
humans; produced tumors
of the liver, pituitary gland
and leukemias in animals;
skin, liver, and reproductive
system effects

Prevent skin and eye contact

Compound metabolizes to
beta-naphthylamine,
a known carcinogen

Pulmonary function
testing and chest
x ray required

Blood testing required;
female workers of child-
bearing age and nursing
mothers to be warned
of potential adverse
effects

Fire-related incidents
involving PCB's have
resulted in wide-
spread contamination of
buildings with PCB's
and, in some cases, with
PCDF's and PCDD's including
TCDD. Emergency response
personnel, maintenance
or cleanup workers, or
building occupants may
be exposed to these
compounds.

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Potential Hazard*	OSHA PEL'S/ Standard	REL'S [†] /Other Recommendations
Precast concrete products industry, comprehensive safety recommendations for (Technical Guideline June 1984)	Many aspects covered under numerous OSHA regulations for general industry (29 CFR 1910)	Various recommendations for safe work practices and worker training
beta-Propiolactone (NIOSH testimony at OSHA hearing September 1973)	No PEL Cancer-suspect agent Stringent workplace controls, recordkeeping, and medical surveillance required 29 CFR 1910.1013	Ca Use 29 CFR 1910.1013
Refined petroleum solvents (July 1977)	2,900 mg/m ³ (500 ppm), 8-hr TWA (Stoddard solvent)	Kerosene: 100 mg/m ³ TWA all other solvents: 350 mg/m ³ TWA; 1,800 mg/m ³ ceiling (15 min)
Silica, crystalline (November 1974)	250/%SiO ₂ +5 in mppcf, or 10 mg/m ³ /%SiO ₂ +2 (respirable quartz)	50 µg/m ³ TWA, respirable free silica
Sodium hydroxide (September 1975)	2 mg/m ³ , 8-hr TWA	2 mg/m ³ ceiling (15 min)

NIOSH

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	Health Effect(s) Considered ³	Comments
ions s	Injury and death	Equipment, conditions, and many of the tasks specific to the industry are not covered under the existing regulations
13	Potential for cancer in humans; produced tumors of the liver, skin, and stomach in animals	None
3 TWA; 0 mg/m ³ ceiling	Eye, nose, and throat irritation; dermatitis; nervous system effects	Blood and urine monitoring required; action level for petroleum ether, rubber solvent, naphtha: 200 mg/m ³ TWA; action level for mineral spirits and Stoddard solvent: 350 mg/m ³ TWA; action level for kerosene: 100 mg/m ³ TWA; prevent skin contact
irable	Chronic lung disease (silicosis)	Chest x ray, pulmonary function testing required
min)	Respiratory irritation	Prevent skin and eye contact

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Styrene (September 1983)	100 ppm, 8-hr TWA; 200 ppm acceptable ceiling; 600 ppm maximum ceiling (5 min in 3 hr)	50 ppm (213 mg/m ³); 100 ppm (426 mg/m ³)
Sulfur dioxide (February 1974; revised May 1977 as part of NIOSH testimony at OSHA hearing)	5 ppm (13 mg/m ³), 8-hr TWA	0.5 ppm (1.3 mg/m ³)
Sulfuric acid (June 1974)	1 mg/m ³ , 8-hr TWA	1 mg/m ³ TWA
2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin (TCDD) (CIB January 1984)	None	Ca Reduce exposure to lowest feasible level
1,1,1,2-Tetrachloroethane (CIB August 1978)	None	To be handled in workplace with care
1,1,2,2-Tetrachloroethane (December 1976; revised in CIB August 1978)	5 ppm (35 mg/m ³), 8-hr TWA (Skin)	Ca Reduce exposure to lowest feasible level

*Date recommendation was published or testimony presented is in parentheses.

†NIOSH TWA recommendations are based on exposures up to 10 hours per week.

§Unless otherwise noted health effects cited are for humans.

3 mg/m³) TWA;
26 mg/m³) ceiling

Nervous system effects;
eye and respiratory
system irritation;
reproductive system effects

Prevent skin contact;
workers to be warned
of possible adverse
reproductive effects

mg/m³) TWA

Respiratory effects

Pulmonary function testing
required

WA

Pulmonary irritation

Prevent skin and eye contact

posure to lowest
el

Potential for cancer in
humans; produced tumors
at many sites in animals;
chloracne

None

ed in the
with caution

Central nervous system
effects; possible liver
and kidney effects

Exposures should be
minimized due to the
structural similarity
to the carcinogenic
chloroethanes

posure to
ible level

Potential for cancer in
humans; produced tumors
of the liver in animals;
liver, gastrointestinal, and
nervous system effects

Prevent skin contact;
blood monitoring
required

parentheses.
ours unless otherwise noted.

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**Potential
Hazard***

**OSHA PEL'S/
Standard**

**REL'S†/Other
Recommendations**

Tetrachloro-
ethylene
(July 1976;
revised
January 1978
in CIB)

100 ppm, 8-hr TWA;
200 ppm acceptable
ceiling; 300 ppm
maximum ceiling
(5 min in 3 hr)

Ca
Minimize workplace ex-
posure levels; limit number of
workers exposed

Thiols: n-alkane
mono thiols,
cyclohexanethiol,
and benzenethiol
(September
1978)

Butylmercaptan: (1-butanethiol)
10 ppm (35 mg/m³), 8-hr TWA;
ethylmercaptan (1-ethanethiol):
10 ppm (25 mg/m³) ceiling;
methylmercaptan
(1-methanethiol):
10 ppm (20 mg/m³) ceiling

All values in ppm (mg/
m³) ceilings (15 min):
1-methanethiol: 0.5 (1.3)
1-ethanethiol: 0.5 (1.3)
1-propanethiol: 0.5 (1.3)
1-butanethiol: 0.5 (1.8)
1-pentanethiol: 0.5 (2.0)
1-hexanethiol: 0.5 (2.0)
1-heptanethiol: 0.5 (2.0)
1-octanethiol: 0.5 (3.0)
1-nonanethiol: 0.5 (3.0)
1-decanethiol: 0.5 (3.0)
1-undecanethiol: 0.5 (3.0)
1-dodecanethiol: 0.5 (3.0)
1-hexadecanethiol: 0.5 (3.0)
1-octadecanethiol: 0.5 (3.0)
cyclohexanethiol: 0.5 (3.0)
benzenethiol: 0.1 (0.5)
Mixtures of thiols to be
controlled by calculation
of equivalent concentration

NIOSH

as	Health Effect(s) Considered ⁵	Comments
ence exposure er of	Potential for cancer in humans; produced tumors of the liver in animals	None

(mg/m ³)	Irritation; eye, skin, blood, and nervous system effects	Blood and urine monitoring required; prevent skin contact
0.5 (1.0);		
5 (1.3);		
9.5 (1.6);		
5 (1.8);		
5 (2.1);		
5 (2.4);		
0.5 (2.7);		
5 (3.0);		
5 (3.3);		
5 (3.6);		
0.5 (3.9);		
0.5 (4.1);		
sol: 0.5 (5.3);		
ol: 0.5 (5.9);		
t: 0.5 (2.4);		
I (0.5);		
s to be		
ulation of		
ntrations		

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o-Tolidine
(August 1978)

None

Ca
20 $\mu\text{g}/\text{m}^3$ ceiling (60 min)

o-Tolidine-based
dyes (Joint
NIOSH/OSHA
Health Hazard
Alert
December 1980)

None

Ca
Should be handled in the
workplace with caution;
minimize exposures

Toluene
(January
1974)

200 ppm, 8-hr TWA;
300 ppm acceptable
ceiling; 500 ppm
maximum ceiling
(10 min)

100 ppm (375 mg/m^3),
8-hr TWA; 200 ppm (750
ceiling (10 min)

Toluene
diisocyanate
(July 1973;
revised—see
Diisocyanates
September 1978)

0.02 ppm (0.14 mg/m^3)
ceiling

0.005 ppm (0.036 mg/m^3)
0.02 ppm (0.14 mg/m^3)
(20 min)

1,1,1-Tri-
chloroethane
(July 1976)

350 ppm (1,900 mg/m^3),
8-hr TWA

350 ppm (1,910 mg/m^3)
(15 min); action level
set at 200 ppm
(1,091 mg/m^3) TWA

1,1,2-Tri-
chloroethane
(CIB
August 1978)

10 ppm (45 mg/m^3),
8-hr TWA (Skin)

Ca
Reduce exposure to
lowest feasible level

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§Unless otherwise noted health effects cited are for humans.

30 min)

Bladder cancer;
nasal irritation

Urine testing required;
quarterly urine monitoring
recommended; prevent
skin contact

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in the
ation;
s

Bladder cancer

Substitute less toxic
dyes wherever possible

/m³),
m (750 mg/m³)

Central nervous system
depressant

None

mg/m³) TWA;
g/m³) ceiling

Respiratory effects

Chest x ray, blood tests,
pulmonary function testing
required

MMWVF

ng/m³) ceiling
vel

Central nervous system,
liver, and cardiovascular
effects

Medical warning of possible
congenital abnormalities
required

to
rel

Potential for cancer in
humans; produced liver
tumors in animals; central
nervous system effects

None

eses.

less otherwise noted.

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Potential Hazard*	OSHA PEL'S/Standard	REL'S [†] /Other Recommendations
Trichloroethylene (July 1973; revised in Special Hazard Review January 1978)	100 ppm, 8-hr TWA; 200 ppm acceptable ceiling; 300 ppm maximum ceiling (5 min in 2 hr)	Ca 25 ppm TWA
Trimellitic anhydride (CIB February 1978)	None	Should be handled in the workplace as an extremely toxic substance
Tungsten and cemented tungsten carbide (September 1977)	None	Insoluble tungsten: 5 mg TWA; soluble tungsten: 1 TWA; dust of cemented carbide (containing > 2% 0.1 mg Co/m ³ TWA; dust of cemented tungsten ca (containing > 0.3% nick 15 µg Ni/m ³ TWA
Ultraviolet radiation (December 1972)	None	For spectral region of 315-400 nm: 1.0 mW/c periods > 1,000 sec; for ≤ 1,000 sec, 1,000 mW (1.0 J/cm ²); for spectral 200-315 nm: consult criteria document
Vanadium (August 1977)	Vanadium pentoxide (dust): 0.5 mg/m ³ ceiling; (fume): 0.1 mg/m ³ ceiling; ferrovanadium: 1 mg/m ³ , 8-hr TWA	Vanadium compounds: 0.05 mg V/m ³ ceiling (1) metallic vanadium and vanadium carbide: 1 mg V/m ³ TWA

NIOSH

Health Effect(s)
Considered⁵

Comments

Potential for cancer in humans; produced liver tumors in animals; central nervous system effects

Workers to be warned of hazards; 25 ppm level can be achieved by use of existing engineering control technology

Pulmonary edema; immunologic sensitization; irritation of pulmonary tract, eyes, nose, and skin

Limit exposure to as few workers as possible while minimizing workplace levels

Lung and skin effects

Pulmonary function testing and chest x ray required

Skin and eye effects

None

Eye, skin, and lung effects

Pulmonary function testing and chest x ray required

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Vibration syndrome (CIB March 1983)	None	Jobs should be redesigned to minimize the use of vibrating handtools; power handtools should be redesigned to minimize vibration
Vinyl acetate (September 1978)	None	4 ppm (15 mg/m ³) ceiling (15 min)
Vinyl chloride (March 1974; reaffirmed June 1974 as part of NIOSH testimony at OSHA hearing)	1 ppm, 8-hr TWA; 5 ppm ceiling (15 min) 29 CFR 1910.1017	Ca Lowest reliably detectable level
Vinyl halides (September 1978)	None except for vinyl chloride	Ca Vinyl halides to be controlled as specified for vinyl chloride in 29 CFR 1910.1017 with eventual goal of zero expo
Waste anesthetic gases and vapors (March 1977)	None for substances when used as anesthetic agents	Halogenated anesthetic ag 2 ppm ceiling (1 hr); nitrou oxide: 25 ppm TWA during of use
Xylene (May 1975)	100 ppm (435 mg/m ³), 8-hr TWA	100 ppm (434 mg/m ³) TV 200 ppm (868 mg/m ³) ce (10 min)
Zinc oxide (October 1975)	5 mg ZnO/m ³ , 8-hr TWA	5 mg ZnO/m ³ TWA; 15 m ceiling (15 min)

*Date recommendation was published or testimony presented is in parentheses.

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§Unless otherwise noted health effects cited are for humans.

igned owered	Vibration syndrome; adverse circulatory and neural effects in the fingers	None
iling	Irritation	None
able	Liver cancer	Liver function testing required
d with exposure	Liver cancer for vinyl chloride; potential for cancer from the other vinyl halides that have produced liver and kidney tumors in animals	Vinyl halides include vinyl chloride, vinylidene chloride, vinyl bromide, vinyl fluoride, and vinylidene fluoride monomers
tic agents: nitrous during periods	Reproductive system effects and audiovisual performance decrements	Workers to be advised of potential effects; abnormal outcome of pregnancies of workers and spouses to be documented
³) TWA; ³) ceiling	Central nervous system depressant; respiratory irritation	None
15 mg ZnO/m ³	Metal fume fever	None

s.
s otherwise noted.

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